

QRA FOR THE STATE-LICENSED DISPOSAL AREA

RELEASE CATEGORIES AND DOSE ASSESSMENT

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QRA MODEL STRUCTURE

- Threat Analysis
- Scenario Analysis
- **Release Category Analysis**
- Transport Analysis
- Dose Analysis

QUANTITIES OF INTEREST

Water releases to water

Radioactive material release quantity to Buttermilk Creek
Buttermilk Creek flow rate at receptor

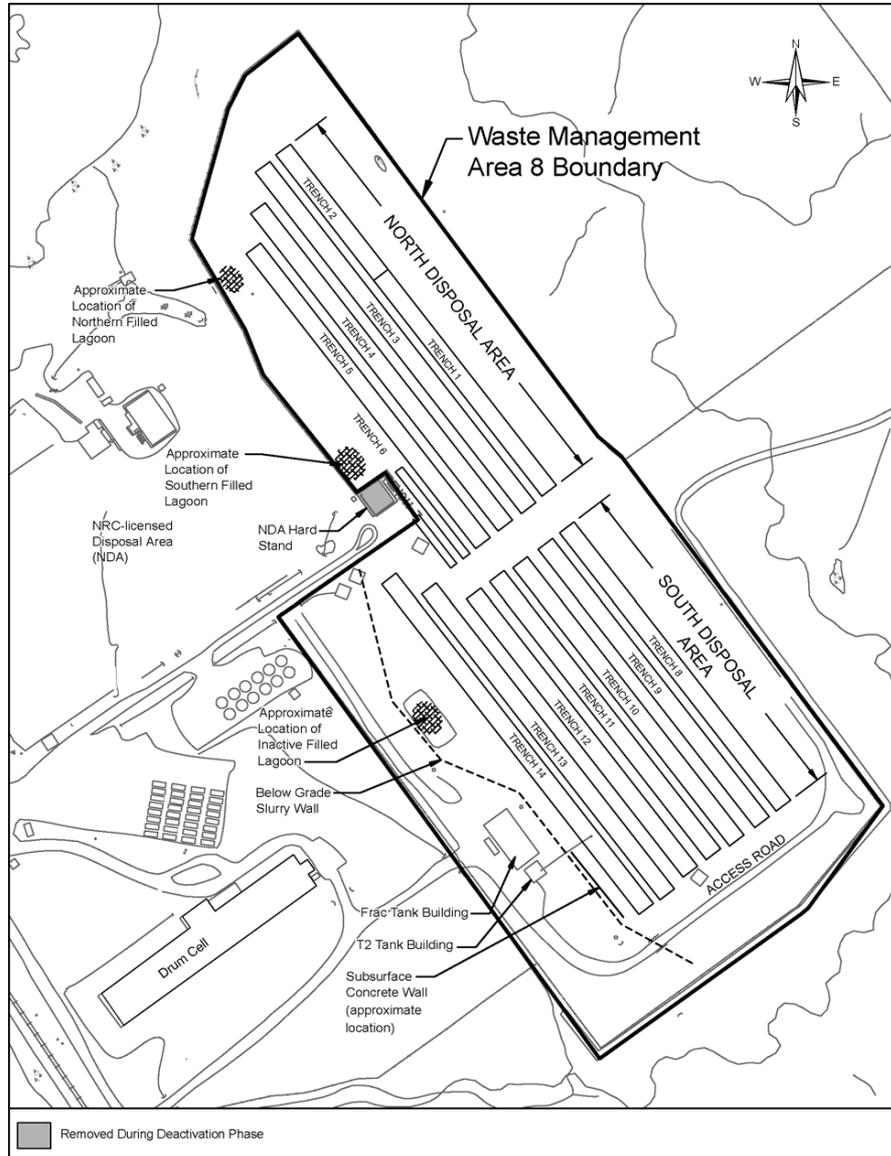
Solids releases to water

Radioactive material concentration in trench solids
Trench solids release quantity
Solids dilution factor at receptor points

Solids releases to air

Radioactive material concentration in trench solids
Trench solids release quantity
Airborne contaminant dilution at receptor points

TRENCH LAYOUT





A TYPICAL TRENCH

Volume—300,000-400,000 cubic feet

Fluid volume—15,000 to 30,000 cubic feet

Waste volume—170,000 to 300,000 cubic feet

Waste mass (at assumed 1.6 g/cc)— $1.6E6$ to $3.0E6$ pounds

Soil fill mass (at assumed 1.6 g/cc)— $7.2E6$ to $1.8E7$ pounds

Waste + soil fill— $3.1E7$ - $3.9E7$ pounds

TRENCH RADIOLOGICAL CONTENTS

Waste volume and radiological content based on extensive URS characterization of burial records

High variability in waste material form and nuclide content

Highest radioactive material inventories in Trenches 4, 5, 8-11

Trench 6, 7 excluded—immobile nuclides or small nuclide inventory



TRENCH ACTIVITY (Ci) -- MAJOR NUCLIDES

10^4 - 10^5 —H-3, Cs-137, Pu-238

10^3 - 10^4 —Co-60, Ni-63, Pu-241

10^2 - 10^3 —C-14, Ni-59, Sr-90, U-238, Pu-239, Pu-240,
Am-241

Total—92,000 Ci

Total excluding H-3—53,000 Ci



TRENCH SOLIDS—RADIONUCLIDE CONCENTRATIONS

Trench system-average basis/Trench-average basis

Point estimate—inventory activity/total mass of waste and
soil fill

Uncertainty expression--log-normally distributed multiplier
M1

median = 1, error factor = 3.2

applied to entire nuclide spectrum



TRENCH LIQUIDS-NUCLIDE CONCENTRATIONS

(POINT ESTIMATE)

Trench system-average basis

Point estimate—trench system average concentration in solids/ K_d

Nuclide concentration ranges (pCi/L) for major nuclides:

10^8 - 10^9 —H-3

10^7 - 10^8 —none

10^6 - 10^7 —C-14

10^5 - 10^6 —Ni-63, Sr-90, Pu-238

10^4 - 10^5 —Co-60, Ni-59, Tc-99, I-129, Cs-137, U-234,

U-238, Pu-241



TRENCH LIQUIDS-NUCLIDE CONCENTRATIONS (UNCERTAINTY)

Uncertainty expression for K_d --log-normally distributed multiplier M_2

median = 1, error factor = 20.4

applied to entire nuclide spectrum

Uncertainty expression for nuclide concentration in liquid is M_1/M_2

median = 1, error factor = 24.2

applied to entire nuclide spectrum

QRA MODEL STRUCTURE

- **Threat Analysis**
- **Scenario Analysis**
- **Release Category Analysis**
- **Transport Analysis**
- **Dose Analysis**



DOSE ANALYSIS OBJECTIVE

Probability distributions of consequence end point,
conditional on radioactive material release category

End point—maximum annual radiation dose (TEDE), a
quantity comparable to 10 CFR Part 20 limits for doses
to members of the public.



RECEPTORS AND EXPOSURE PATHWAYS

Resident farmer on Buttermilk Creek near confluence with Cattaraugus Creek (all scenarios releasing trench water to streams)

Inhalation; direct exposure to nuclides in irrigated soils; incidental direct exposure to nuclides in sediments; consumption of crops containing directly deposited radionuclides and grown in soils containing deposited nuclides; and consumption of food products from animals fed crops containing directly deposited nuclides and grown in soils containing deposited nuclides

Hiker along Buttermilk Creek and Franks Creek (scenarios releasing trench solids to streams)

Direct exposure to soils (sediments) containing radionuclides and incidental ingestion of small quantities of stream sediments

Resident-farmer >0.5 miles from the SDA (scenarios releasing trench solids to air)

Inhalation; direct exposure to soils containing deposited nuclides; consumption of crops containing directly deposited nuclides and grown in soils containing deposited nuclides; consumption of food products from animals fed crops containing directly deposited nuclides and grown in soils containing deposited nuclides

DOSE COMPUTATION

GENII-V2

Default parameter values for parameters not related to source (no seasonal effects)

ICRP 30 dose factors (compatible with 10 CFR Part 20 limits for doses to members of the public)

RELEASE OF TRENCH WATER NUCLIDES TO SURFACE WATER

Dose is proportional to time-integrated nuclide concentration in Buttermilk Creek water.

Compute normalized receptor dose (1-day receptor withdrawal of water with nuclide concentrations equal to concentrations in trench water)

DOSE FROM NUCLIDES IN TRENCH WATER

Poorly retarded nuclide spectrum (H-3, C-14, I-129, Tc-99 only)

Point estimate: 2.42E2 millirem in 1 year

Dose = $2.4E2 * DF * T_{rel}$, where

DF=effective trench water dilution factor <1, T_{rel} =release duration, days

Uncertainty: lognormal, median=point estimate, 2.5%-97.5% range=1.2E2 to 4.8E2

All nuclide spectrum

Point estimate: 4.8E3 millirem in 1 year

Dose = $4.8E3 * DF * T_{rel}$

Uncertainty: lognormal, median=point estimate, 2.5%-97.5% range=1.6E3 to 1.4E4



RELEASE OF TRENCH SOLIDS TO STREAMS

Dose is proportional to nuclide concentration in trench solids.

Compute normalized dose (normalized to dilution factor of 1)

Point estimate: $2.49E4$ millirem in one year

Dose = $2.49E4 * DF$, where

$DF = \text{exposure-time-weighted soil dilution factor} < 1$

Uncertainty: uniform, median=point estimate, range= $1.25E4$ to $3.74E4$



RELEASE OF TRENCH SOLIDS TO AIR

Dose is proportional to nuclide concentration in trench solids and mass of trench solids ejected into air.

Compute dose for conservative point estimate of 495 kg of trench solids ejected (produced by explosion of 100,000 pounds of jet fuel).

Point estimate: 12.2 millirem in one year

Uncertainty: lognormal, median=point estimate, 2.5%-97.5% range=4.1 to 36.5